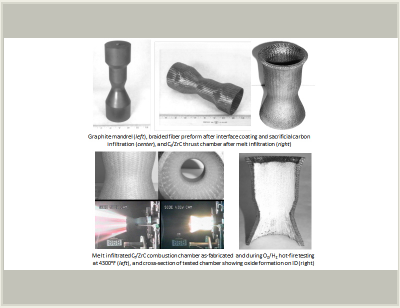
Small Business Innovation Research/Small Business Tech Transfer

Low-Cost, Lightweight, High-Performance CMC Combustion Chamber for HAN-Based Monopropellant Engines, Phase I

Completed Technology Project (2015 - 2015)

Project Introduction

Non-toxic storable liquid propulsion systems are of great interest for use in future exploration missions. Efficient propulsive performance and long-duration storage attributes have made the use of hydrazine widespread across the aerospace community. However, hydrazine is highly corrosive and toxic, creating a need for non-toxic, high-performance propellants for NASA, other government agencies, academia, and the commercial space industry. Handling and safety concerns with the current toxic chemical propellants can lead to more costly propulsion systems; the use of new non-toxic propellants has the potential to reduce the cost of access to space by lowering overall life cycle costs. In this project, Ultramet will design and fabricate a lightweight, high temperature ceramic matrix composite (CMC) combustion chamber for use with the AF-M315 family of monopropellants, all of which have specific impulse values ranging from 263 to 288 sec and combustion temperatures up to 2300? C. The CMC combustion chamber material will be selected to offer the lightest possible weight, lowest cost, and highest performance available to reach the needs of the application, and will be fabricated using Ultramet's proven melt infiltration processing technology. Ultramet will work closely with a leading supplier of spacecraft propulsion systems that will provide chamber design and engineering guidance. Detailed analytical studies based on proven predictive analysis methods will be performed, and will be coupled with fabrication, optimization, and characterization of attractive CMC combustion chamber material options. The goal is to develop a CMC chamber design and fabrication process that will yield a thrust chamber that is hot-fire test-ready at the conclusion of the project. Hot-fire testing to demonstrate the survivability of the material system will be performed at the beginning of Phase II, which would also include long-duration life testing.



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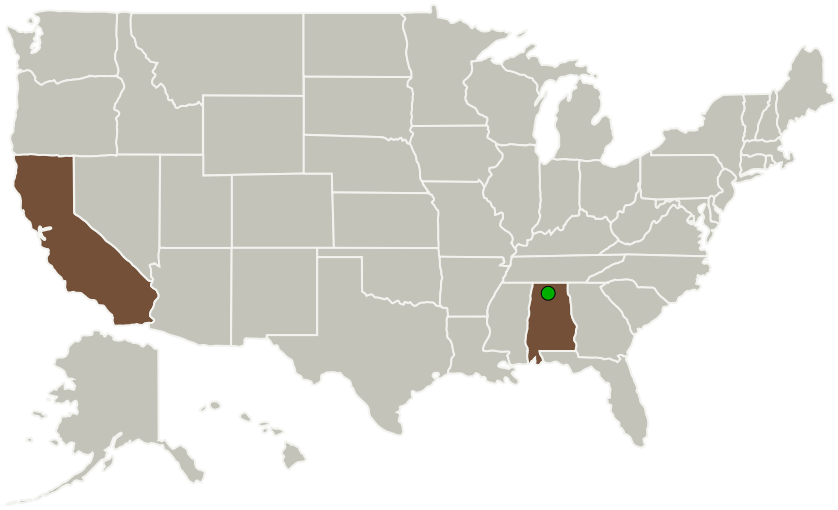
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Ultramet	Lead Organization	Industry	Pacoima, California
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	California

Project Transitions

June 2015: Project Start

December 2015: Closed out

Closeout Summary: Low-Cost, Lightweight, High-Performance CMC Combustio n Chamber for HAN-Based Monopropellant Engines, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/139186)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ultramet

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

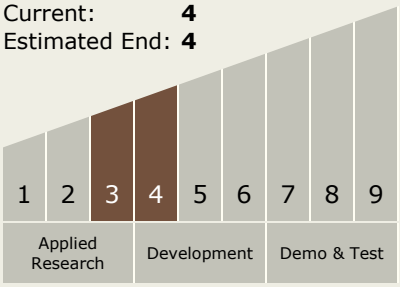
Carlos Torrez

Principal Investigator:

Timothy R Stewart

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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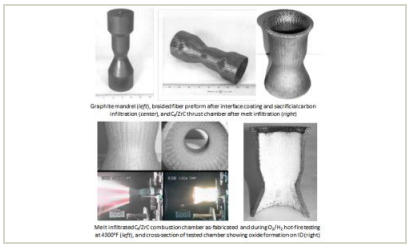
Images



Briefing Chart Image
Low-Cost, Lightweight, High-Performance CMC Combustion Chamber for HAN-Based Monopropellant Engines, Phase I
(https://techport.nasa.gov/image/135467)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.2 Earth Storable

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System